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Inside Geopolitics of Energy

Tanking Up
The Commercial and Strategic Significance of China's Growing Tanker Fleet

by Gabriel B. Collins and Andrew S. Erickson*

Executive Summary

Chinese shipping firms are aggressively expanding their oil tanker fleets. China's state energy firms support national energy security goals in their rhetoric, and China's state shipbuilders are striving to lead global production, but commercial forces will almost certainly determine how these ships are employed—at least in peacetime. Chinese naval development seems focused on Taiwan and other territorial areas, leaving Beijing's ability to actively protect its own energy transport routes embryonic, at best. Yet the majority of new tankers being built for Chinese shipping firms will fly China's flag, thereby setting a legal basis for militarily protecting these vessels should hostilities erupt.

"...once oil imports exceed [1.5 million barrels per day], it becomes necessary to use economic, diplomatic, and military means to secure the safety of one's oil supply."[1]

China's share of total world oil consumption will likely more than double in the next 15 years. Despite likely future increases in oil imported overland, China will continue to rely on maritime transport for the majority of its increasing oil imports. In 2006, 76 percent of Chinese oil imports came from the Middle East and Africa. A new pipeline from Kazakhstan will likely carry up to 200,000 bbl/day within the next year and up to 400,000 bbl/day by 2011. A similar pipeline to supply China with 200,000 bbl/day of Russian oil will come fully online in the 2009-10 timeframe, adding as much as 500,000 bbl/day of total new overland supply.[2] A major new oilfield discovered in the Bohai Gulf by PetroChina could deliver up to 200,000 bbl/day within three years, for a total of ~700,000 bbl/day of additional non-maritime oil supply by 2010.[3]

Yet even assuming a conservative 8 percent growth in annual demand (as compared to 14.5 percent in 2006), Chinese oil demand would increase by more than 1 million bbl/day during that same three year period. Moreover, as Table 1 indicates, seaborne oil imports are the most cost effective option. Thus, for the foreseeable future, China's seaborne oil imports will continue to increase and to represent the dominant share of overall oil imports. In 2006, over 85 percent of oil entering China came by sea.

Table 1: Sample Oil Transport Costs to China

Transport Mode	Route	Distance (km)	Total Cost ($/bbl)	Cost/bbl/1,000 km
Tanker*	Ras Tanura-Ningbo	7,000	1.14	0.163
Pipeline**	Angarsk-Skovorodino	2,700	2.14	0.793
Train***	Angarsk-Manzhouli	1,000	7.19	7.190

*VLCC at $65/day, 2 million bbl cargo.
**Based on Russian Transneft tariff of $0.58/ton/100 km.
***Based on weighted average of Russian Railway's oil tariffs to Zabaikalsk and Naushki.

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Driven by concerns of energy insecurity, China's leadership desires control over the entire oil supply chain in order to guarantee its oil supply during times of crisis.[4] Accordingly, it advocates building a national tanker fleet capable of hauling up to three quarters of Chinese oil imports by 2020.[5] By 2010, China intends to transport 40-50 percent of its oil imports on PRC-flagged tankers. By 2020, it hopes to carry 60-70 percent.[6] Chinese analysts predict that by 2010, the country will need more than 40 very large crude carriers (VLCCs), each of which can carry 1.5 million or more barrels of oil.[7]

A large, state-flagged tanker fleet may help ensure the security of China's oil imports because it could deter a future adversary from interdicting China-bound tankers to pressure China's leadership. This would be particularly true in crisis situations short of a shooting war. The possibility also exists, however, that Chinese tanker operators may, in effect, be manipulating Beijing's oil insecurity for commercial gain. The key variable is the relationship between China's government and its national oil companies, which, if left to their own devices, typically put profits before politics.

Some observers characterize China's tanker buildup as a "centrally driven plan." This remains a point of contention. The authors' interviews with Chinese scholars familiar with the central government's current energy policies suggest that Beijing has no coherent plan at present for the creation of a national tanker fleet. However, articles from state-controlled New China News Agency and *China Daily* feature analyst Luo Ping from the National Development and Reform Commission (NDRC)-affiliated Institute of Comprehensive Transportation (ICT) calling for at least 60 percent of oil imports to be carried by Chinese shipping companies, who are now rapidly expanding their tanker fleets.[8] According to *China Daily*, Peng Cuihong, a senior official at the Ministry of Communications' Water Transport Department, has stated that China will build additional oil tankers to reduce reliance on foreign tankers.[9] Another *China Daily* article cites Cao Desheng, deputy director of Peng's department, as requiring foreign investors in China's shipping industry to "register their companies in China" and have their ships "fly the Chinese flag" so that in "'special times like wars, ships flying foreign flags and with foreign sailors won't be able to take shelter in the country,'" in which case "'essential materials such as oil will be threatened.'"[10]

Perhaps most significantly, a *China Daily* editorial, which would not appear without at least tacit official support, echoes Luo's call, stating that "The best way to minimize our vulnerability is to increase our preparedness for less than normal times. It is well within our reach to have more than 60 percent of our oil imports carried by Chinese-flag tankers... [this] will help guarantee a more comfortable position in the kind of special times we hope will never come."[11]

Chokepoint Concerns

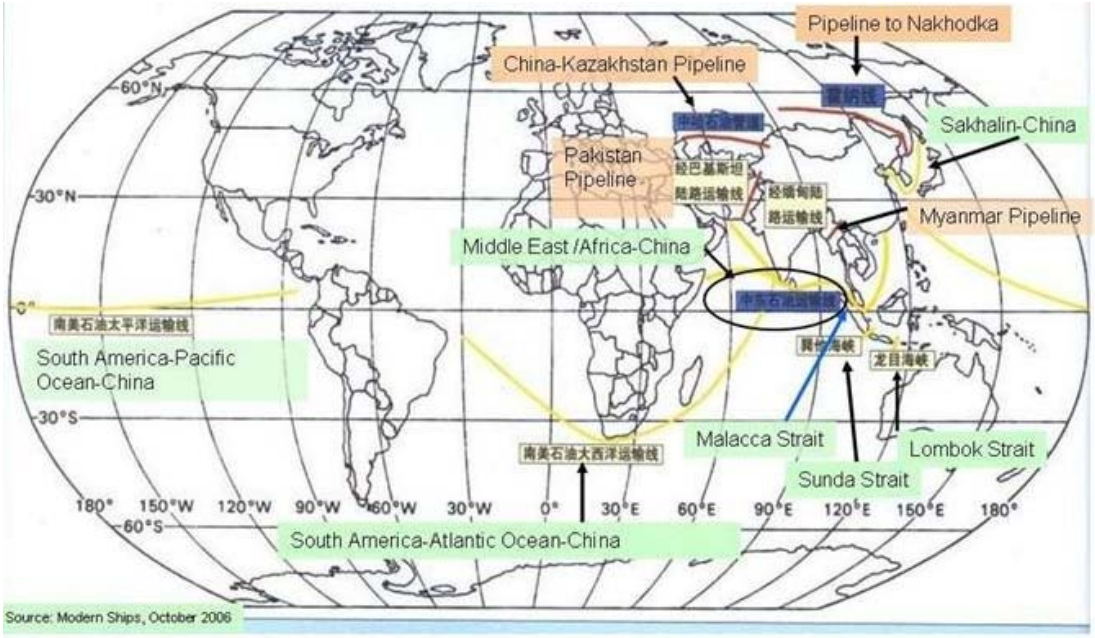
The "Malacca Dilemma" lies at the heart of Chinese security analysts' feelings of oil insecurity. Chinese analysts believe that whoever controls Malacca also controls China's oil security, since more than 85 percent of Chinese oil imports pass through Malacca (see Figure 1). They fear that these bottlenecks could be easily closed by terrorism, piracy, or the navies of the US or regional powers in the event of conflict over Taiwan or some other serious Sino-American crisis and believe that China's inability to secure the Strait could be "disastrous" for its security.[12]

The U.S. Navy is not viewed as the only threat to China's maritime energy supply lines. Chinese planners worry that the rapidly modernizing Indian Navy could use its naval superiority vis-à-vis China in the Indian Ocean to gain strategic leverage.[13] Beijing also casts a suspicious eye on the Japanese Maritime Self Defense Force (JMSDF), since Japan competes with China for energy resources in Russia and the East China Sea, and because the JMSDF cooperates with both the US and Indian navies.[14]

Despite media reports of plans for a pipeline through Myanmar to China's Yunnan Province or a "Malacca bypass" pipeline across southern Thailand's Kra Isthmus, China is likely to rely on transit of oil shipments through Malacca for the foreseeable future because new shipping routes would be longer and more expensive.

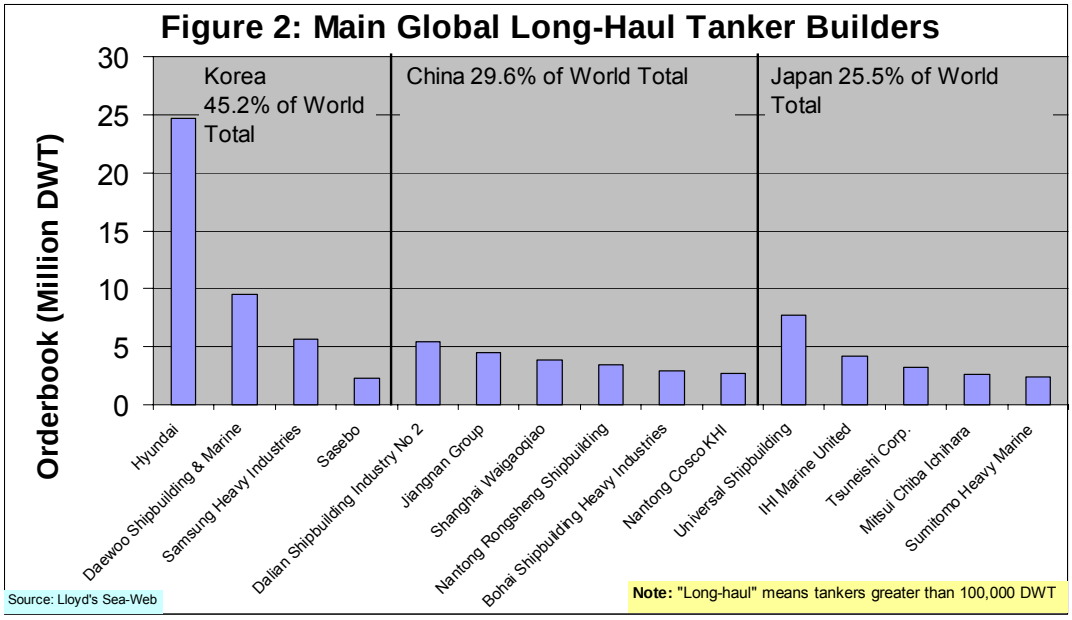
Much of the Chinese internal discussion on the tanker fleet buildup centers on security arguments. However, at present, commercial motivations appear to be the fundamental drivers of China's quest for a large, long-haul tanker fleet.

Figure 1: Conceptual Map of Key Chinese Oil Transport Routes
(from Xiandai Jianchuan [*Modern Ships*] October 2006)



Commercial Drivers

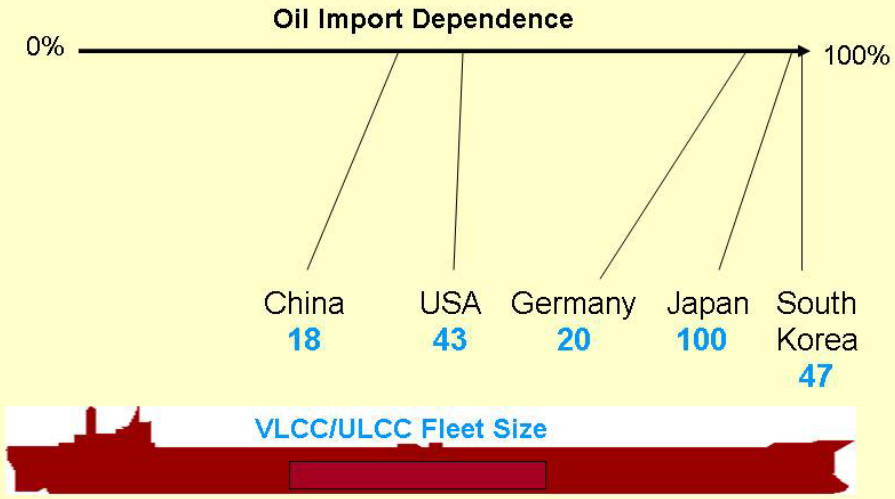
China aspires to be the number one global shipbuilder by 2015. This plan is laid out in official policy statements and is rapidly being implemented.[15] South Korea in particular faces a major competitive threat from Chinese tanker builders hungry for work. Figure 2 shows global long-haul tanker builders with order books exceeding 2 million DWT as well as their home country's total share of global long-haul tanker newbuilds.



Beijing has powerful economic incentives to bolster its shipbuilding sector. Shipbuilding boosts the entire industrial chain (e.g., steel industry; metallurgical and machine-tool sectors). VLCCs recently built in Chinese yards have required approximately 884,000 man-hours to complete.[16] Chinese sources calculate that, in general, every 10,000 DWT built can create 100,000-200,000 man-hours of employment for Chinese workers.[17] Thus, direct shipyard labor accounts for only about 15-20 percent of the entire amount of employment generated by building a ship. At present, China's shipbuilding industry directly employs more than 275,000 workers.[18] Thus, on the basis of job creation alone, China's government has good reason to support its shipbuilders.

As mentioned earlier, Chinese ship owners and operators presently control 18 VLCCs. Roughly half of the vessels (by hulls, not tonnage) in China's fleet are small, old tankers better suited for the coastal and short haul trades than for international oil transport. Meng Qinglin, a senior manager of Dalian Ocean Shipping Company, estimates that Chinese tankers are 30 percent older than the international norm.[19] The ships' average carrying capacity is also better suited to medium-distance oil carriage, rather than the long trip from Africa or the Persian Gulf, as Chinese crude oil tankers average 116,000 DWT (as opposed to the Japanese fleet's average of nearly 200,000 DWT per vessel). Figure 3 compares China's current VLCC fleet with those of other major oil importers.

Figure 3: Oil Import Dependency vs. Tanker Fleet Size



Note:
Figures based on ownership by group owners, registered owners, operators, ship managers, and DOC holders

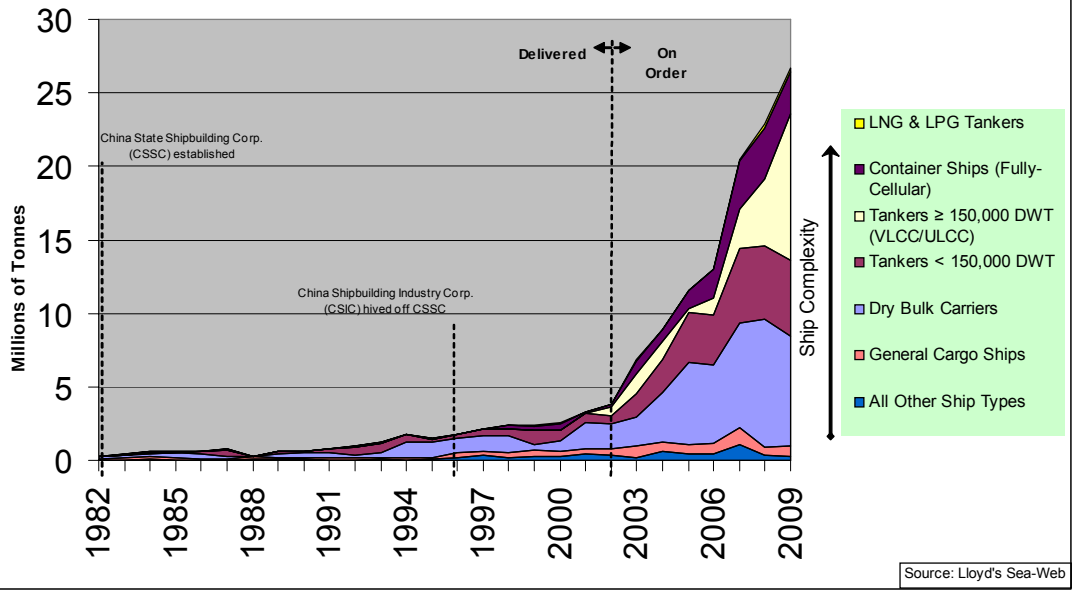
Source: Lloyd's Sea-Web, BBC

China is now one of the world's leading tanker builders. Chinese shipyards have captured 30 percent of global VLCC newbuild orders. Tankers form a major portion of Chinese yards' output and will continue to do so, as shown in Figure 4.

Figure 4 demonstrates the success of Chinese firms in winning orders for new tankers. According to *Lloyd's Sea Web*, of the 21 million DWT of Suezmaxes and VLCCs currently on order or under construction in Chinese yards, roughly 13 million DWT are being built for foreign operators. Although China lags Japan and Korea in technology and yard management practices, the large number of foreign tanker orders seems to endorse the Chinese shipbuilding industry's increasing quality at unbeatable prices. Western ship owners interviewed by the authors indicate that Chinese yards' low prices, as well as a desire to establish relationships with rapidly growing Chinese shipbuilders, drive their current orders.[20] Chinese ship quality, which recently was suspect, is rapidly improving, even if it is not yet at the high level of South Korean- and Japanese-built vessels. Reflecting this increase in quality, foreign buyers are considering ordering chemical tankers and other more complex ships, in addition to the tankers and bulk carriers that have thus far dominated their orders.[21]

While two of China's large state-run shipyards (Shanghai Waigaoqiao and Dalian No. 2) are considered to be among the world's top 10, other yards still experience regular delays and quality control problems. China's entire ship subcomponents industry remains weak: Chinese yards are excellent at hull fabrication but must import many key internal parts. Indeed, South Korean builders have even begun to construct hull blocks in China and barge them back to South Korea for final assembly. To boost the subcomponents industry, Chinese yards often force ship buyers to source engines and other subcomponents in China when they order vessels. Otherwise,

Figure 4: PRC Shipbuilding Production by Deadweight 1982-2009



ship buyers interviewed by the authors indicate they would favor Korean and Japanese made engines and other internal parts. In sum, China's low labor costs and large land areas for yard expansion give it a distinct edge in building bulk carriers, tankers, and other less complex "commodity" ships. Chinese yards' current orderbooks indicate a continued focus on building tankers and bulk carriers over the next 2-3 years.

Shipping Firms' Relationship with Beijing

Beijing's relationship with tanker operators is best characterized as "the government builds the stage and the companies play." The government sets certain ground rules, but the companies enjoy substantial freedom to pursue their own commercial objectives within understood limits. This relationship probably extends to building national oil transport capability as well.

Managers of shipping companies generally appear content to let the central government promote the shipbuilding/shipping industry at the broad policy level. In fact, a Chinese energy expert has told one of the authors the idea of a Chinese national oil tanker fleet is a "rhetorical device for China's shipbuilding industry to justify more central government interest."[22] Yet, like state oil companies, they may resist government meddling in their daily operations. If chartering tankers to national and private operators worldwide on an individual basis is more profitable than serving Chinese national oil companies in accordance with central policy directives, shippers will favor the more profitable approach. Similarly, if national energy companies find it more cost-effective to have foreign tanker operators haul their oil, they may oppose a forced marriage with Chinese oil shipping firms.

Observers will be able to learn more about these relationships once Chinese state-owned shipping firms such as COSCO start taking large-scale VLCC deliveries, perhaps as early as late 2007 and early 2008. To better understand how Chinese shipping companies and national oil companies will interact, analysts will need access to significant chartering data spanning at least a year. One data point of note is that according to state newspaper *China Daily*, CNPC and Sinopec are slated to work with China Changjiang National Shipping Group Corporation and China Shipping Group Company to form a new shipping company.[23]

At present, an estimated 90 percent of China's oil shipping capacity serves foreign clients.[24] Reassigning these vessels to domestic firms would not help China's long-distance oil transport situation. According to *Lloyd's Sea Web*, only 18 of these ships are VLCCs suitable for economically transporting crude from the Middle East, Africa, and other distant suppliers. The bulk of China's current fleet consists of smaller Aframax, Panamax, and Handysize vessels designed for short-haul oil trading. China will need more than 40 VLCCs to meet its goal of carrying 50 percent of imports on Chinese tankers by 2010.

Attempting to control maritime oil transport will likely cost more than outsourcing oil transport to private shippers. Like other modern oil companies, China's national oil companies rely primarily on independent tanker operators to haul their oil. In 2006, Sinopec chartered two-thirds as many VLCC spot voyages as ExxonMobil (103 to 149). For the year 2007, it may out-charter ExxonMobil.[25]

If Beijing hopes to foster long-term strategic cooperation between domestic oil shippers and the national oil companies (some of which are among the world's leading VLCC charterers), it may have to offer tax breaks and other financial incentives. Otherwise, the shipping firms will likely utilize their ships based almost exclusively on "nationality-blind" commercial criteria.

Financing

As Table 2 indicates, several Chinese shipping firms that specialize in energy shipping, or have substantial positions in the business, have held initial public offerings (IPOs) of stock since 2005.[26] This is another indicator of the fundamentally commercial character of Chinese firms' energy shipping operations. Because Chinese firms (particularly state-owned enterprises, SOEs) are major employers and generate large tax revenues, it is unlikely that Beijing will permit them to sell controlling shares. Foreign and domestic investors are nevertheless likely to pursue these limited options because of restricted access to other investment opportunities within China's energy sector and Beijing's skillful linking of investment, technology transfer, and market access. A senior Chinese energy official has told one of the authors that China is constructing oil tankers not as part of a security-focused central government policy, but rather to gain economic benefits, particularly by reducing tanker financing rates.[27]

Table 2: Sample Chinese Energy Shipping IPOs

	Amount	% of Total Capitalization	Purpose	Date	Exchange
China Merchants Energy Shipping	$727 mil.	35	Fund fleet expansion	November 2006	Shanghai
COSCO Holdings	$1.22 bil.	29	Boost intl. profile, raise capital	June 2005	Hong Kong

SOURCES: Lloyd's List, International Herald Tribune, Nelson's Public Company Profile.

Tanker Market Effects

Some Chinese observers worry that China's aggressive tanker-building program, which is occurring amid record high tanker chartering rates and profits, could outstrip demand and depress tanker rates.[28] Some advocate acquiring secondhand tankers as an antidote. State owned Sinotrans and other Chinese tanker operators are said to be actively scouring the VLCC market for secondhand ships.[29]

Building tankers without close regard for what the ship market can absorb might depress freight rates, however, and could create a situation in which Chinese shipyards profit while shipping companies suffer losses. Many tankers under construction today will enter the market in 2008-09. Continuing strong oil demand growth in the developing world (particularly Asia) will have to be met primarily with long-haul crude imports from the Middle East and could help underpin the VLCC market. Russia's delays in bringing East Siberian crude onto the Asian market may also uphold demand for VLCCs to carry Middle East and African crude. Long-haul product exports from the Middle East will also create incremental VLCC demand in coming years.

Changes to the market for new ships may also increase China's shipbuilding market share without causing undue depression of shipping rates. For example, shipping industry personnel interviewed by the authors indicate that Japanese heavy industrial firms are considering making a gradual exit from shipbuilding. This would open market share for Chinese shipyards, possibly allowing them to accelerate construction efforts without overbuilding.

Crisis Scenarios and Implications

Unless China's navy can attain outright naval and air superiority in a given sea zone, carrying oil in Chinese-flagged tankers during wartime might render Beijing *more* vulnerable to interdiction of its energy supply because—at least in theory—foreign navies could easily determine which tankers were bound for China. It might seem, then, that absent a substantial blue-water

naval capability—which may be decades away—China is making itself a target by constructing a state-controlled, Chinese-flagged tanker fleet.

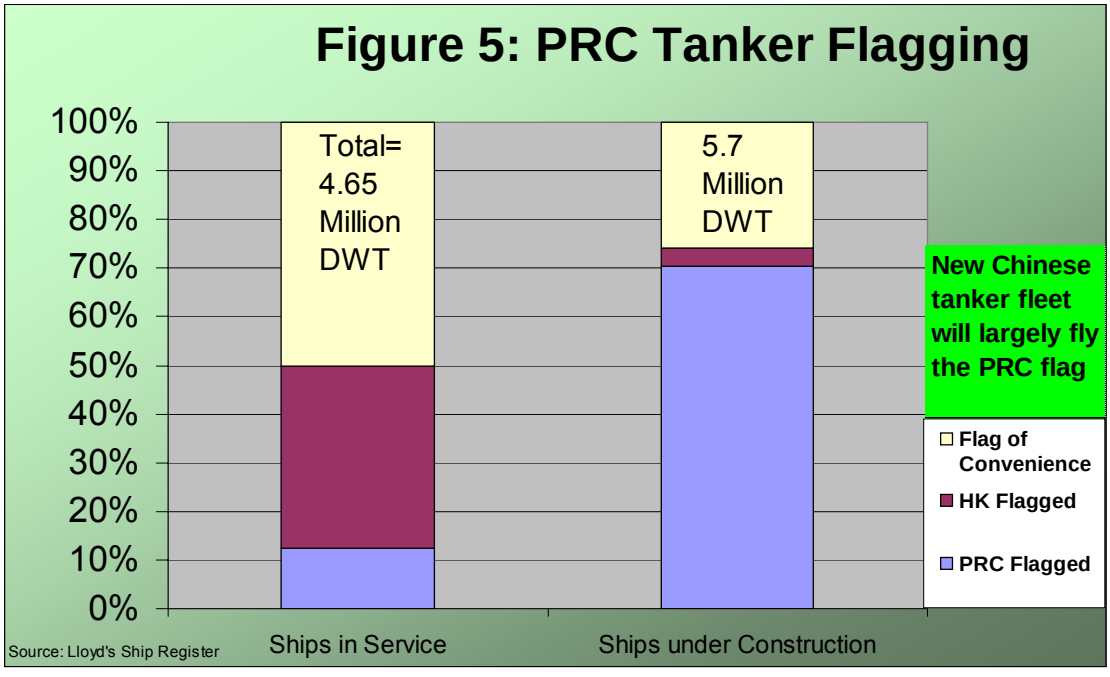
If so, Beijing's best option might be to rely on private third-party tanker operators, whose deliveries could be effectively stopped only by a close blockade of Chinese ports—in turn exposing the blockading state's naval forces to a wide range of military threats and almost certainly sparking a larger conflict whose repercussions would presumably exceed any likely political gains for that state. Alternatively, reflagging Chinese-owned tankers to Liberia, Panama, or another flag-of-convenience state would force an interdicting navy to go to much greater lengths to identify a tanker's ownership and ultimate destination.

Nonetheless, because of international legal norms, having a Chinese-flagged tanker fleet import oil for the government might indeed help to ensure China's energy security during crises short of war. It is likely not lost on China that embargoes and other forms of economic coercion are a key non-kinetic instrument that major powers may use to pressure a foe. Under international law, a PRC-flagged tanker in government service would enjoy the substantial protection of China's flag. If an outside power interdicted such a vessel, China would have grounds to claim that its sovereignty had been breached sufficiently to threaten its national well-being, thereby justifying a serious armed response. The escalatory barrier created by putting state-flagged vessels into government service would thus deter adversaries from interdicting PRC oil shipments unless hostilities were either imminent or already underway. While legal norms are sometimes disputed, sidestepped, or even ignored in wartime, it is difficult to imagine a scenario short of major war in which an adversary would risk triggering escalatory behavior by Beijing.

PRC-flagged tankers hauling oil for any of the state-controlled Chinese producers may be deemed by some states to meet the criteria for sovereign immune status. During a crisis, moreover, oil carried on Chinese-flagged tankers not already being shipped on behalf of PRC state-owned oil companies could rapidly be resold at sea to any number of PRC government entities, thus creating the necessary legal conditions to assert sovereign immune status for the tanker.[30]

Based on *Lloyd's Sea Web* data, thirty one of the 42 VLCCs currently on order in Chinese yards for Chinese shipping companies are slated to fly the PRC flag (of the other 11, 5 will be Panamanian-flagged and 6 will fly Hong Kong S.A.R.'s flag). These VLCCs would be the primary vessels hauling oil through the Indian Ocean and other potentially vulnerable SLOCs. Figure 5 illustrates Chinese shippers' growing tendency to state flag oil tankers.

Interdicting private tankers at sea would be difficult in practice, moreover, because at any given time the ship's bill of lading might not accurately reflect the true end destination of an



oil cargo. In normal commerce, cargoes may be bought and sold dozens of times while still on the high seas. Bills of lading can also easily be falsified, a technique regularly used by smugglers.[31] Finally, unless the blockading power were willing to risk environmental disaster by disabling or sinking uncooperative tankers, it would likely lack sufficient military assets to board and take control of such ships, as fifty-two oil tankers/day pass through the Malacca Strait alone.[32]

Seeking lower insurance rates is another possible rationale for a state tanker fleet. Under normal operating conditions, hull insurance for a tanker is between 2.5 and 3.75 percent on an annualized basis. Thus, the operator of a $130 million VLCC can expect to pay $8,900-13,300/day in insurance costs. However, if insurance firms declare an area a War Risk Exclusion Zone (e.g., in the Persian Gulf), rates can climb to 7.5 to 10 percent of ship value on a *daily* basis, meaning that the same VLCC operator would now have to pay between $8.9 and $13.3 million/day to insure his ship while it was in the danger zone. Assuming three days in the Gulf each time the vessel loaded oil, the operator would have to pay from $26.7 to $39.9 million per trip. Even in the best of markets, VLCCs rarely command more than $100,000/day. Yet to pay off the projected war risk insurance costs, a VLCC making the 33-day trip from the Gulf to East Asia would have to earn more than $1 million/day.

Commercial ship owners would only operate under such conditions if an outside power either paid them such rates, or offered insurance and a guaranteed profit payment as part of an oil transport deal. State-owned ships could conceivably self-insure and forego paying insurance premiums in order to maintain continued oil delivery service to the home country. For all these reasons, a domestically-flagged tanker fleet makes some strategic sense, at least from Beijing's security-focused perspective.

Not all contingencies threatening Chinese energy security involve an armed conflict. A terrorist attack on a Saudi export terminal that suddenly tightened world oil markets, for example, might be sufficient to trigger a government "call" on state-run tankers. It might prove difficult for Beijing to press PRC-flagged tankers into state service during a crisis, however. Assuming that PRC tanker operators followed normal peacetime operating principles, their VLCCs could be chartered out to shippers in places as far afield as Nigeria, Venezuela, or northwest Europe. Given the distances involved, it might take thirty days or more for these vessels to reach Chinese ports, even if they immediately broke contracts and headed for China.

If it had advance warning, China's central government might notify tanker operators ahead of time, pay contract termination penalties, and preposition state-owned tankers for crisis oil deliveries. However, numerous commercial observers carefully track tanker movements, meaning that even covert Chinese preparations would be noticed quickly. Other major powers would rapidly realize that China was marshalling assets, and might interpret such actions as a sign that Beijing anticipated hostilities. Rather than helping to ensure national security, therefore, a decision to call on PRC-flagged tankers during times of major tension could well cause other actors to assume the worst—thereby precipitating a more serious crisis.

The security of China's maritime oil transport lies in the inherent difficulties facing any force trying to disrupt it. It would be very difficult to interdict private tankers bound for Chinese ports. The global oil market is highly fungible; ship destinations are unclear, since cargoes are often resold at sea; and oil can be transshipped to China through third ports in the region. In addition, the number of tankers transiting key chokepoints would likely far exceed any potential blockading navy's physical ability to take control of uncooperative ships, unless it were willing to accept the diplomatic, environmental, and military consequences of using disabling fire.[33] These factors, in addition to the legal considerations mentioned above, explain both Beijing's preoccupation with acquiring state-flagged tankers and why, during peacetime, it can allow Chinese shipping companies to operate them under normal commercial principles.

Conclusion

While China is building a large number of VLCCs and other long-haul crude tankers, Chinese tanker operators will work almost exclusively within the framework of the existing global tanker market, at least during peacetime. It is highly unlikely that China will try to circumvent the existing global tanker market system entirely because the opportunity costs of doing so would be very high. Energy subsidies illustrate the cost of working outside the market to even a modest extent. China already pays its state oil companies billions of dollars in subsidies annually to compensate them for losses incurred by buying oil at market prices and then being forced to sell products derived from that oil at government capped rates within China.

In China's energy sector, national, provincial, and commercial actors often pursue their interests in ways that support their own objectives, sometimes at the expense of Beijing's overall goals. Since China has lacked an Energy Ministry since 1993, it is unclear to what extent larger objectives are conclusively defined and coherently enforced. Tanker operations driven by economic opportunity are more profitable than those driven by state directives. Moreover, Chinese shipyards' and shipping companies' commercial deals with foreign operators are likely to further integrate Chinese firms into the global oil shipping sector. As Chinese naval power and oil import dependency rise, however, security-minded factions in China's leadership may use the country's resource needs to justify both more centralized coordination of energy security policy and further pursuit of blue water naval capabilities to support such policy.

In sum, Beijing appears to be profiting from shipbuilding and tanker operation during peacetime, while attempting to hedge its bets against future threats to oil shipments. While designed to address clear strategic interests, however, such measures could backfire if they led to sustained military buildup and economic mercantilism in a way that challenged the core interests of other Pacific powers and thereby precipitated corresponding reactions on their part. China's leaders would do well to understand that the security of their nation's maritime oil transport lies in the inherent difficulties facing any force trying to disrupt it, rather than on any other single factor.

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[31]This paragraph draws upon Murray and Collins.

[32]Yue Laiqun, "Unavoided Malacca Strait," *China Petroleum Enterprise*, September 2005, p.6.

[33]This paragraph draws upon William Murray and Gabriel Collins, "No Oil for the Lamps of China?," in Gabriel Collins, Andrew Erickson, Lyle Goldstein, and William Murray, *Maritime Implications of China's Energy Strategy* (Annapolis, MD: Naval Institute Press, forthcoming 2008).

Economic Theory and an Unsociable Review of the Global Warming Discussion

*by Professor Ferdinand E. Banks**

Abstract

This article provides a brief and essentially non-technical evaluation of some aspects of the global warming discussion, mainly concentrating on the inadequacy of the Kyoto Protocol as a result of two oversights. The first is the failure of the Kyoto conference on the environment to encourage a larger deployment of nuclear energy in the main industrial nations, while the second is the bizarre promotion by that gathering of global emissions trading (or cap-and-trade schemes) as an efficient scheme for the large-scale reduction in greenhouse gases. Much of the argument in this article is an extension of the chapter on global warming in my new Energy Economics textbook (2007), however, that chapter failed to foresee the recent decision by President George W. Bush to acknowledge scientific evidence relating to global warming. The sections are as follows: 1. Introduction. 2. Not the global warming movie. 3. Nuclear in the light of Kyoto. 4. Emissions trading blues. 5. Conclusions.

Introduction

If the world were as rational as portrayed in most conventional economics textbooks, this contribution would be quite unnecessary. But as George Monbiot (2004) informed his readers: "The dismissal of climate change by journalistic nincompoops is a danger to us all". I think that we can remove "journalistic" from that sentence (and substitute 'eminent'), because I doubt whether, at the present time, the ladies and gentlemen of the press are much different than most of us where this topic is concerned. They too have become more sophisticated in that they are no longer willing to believe that 'scientific truths' retailed by self-appointed 'gurus' are worthy of their attention. It might also be useful to note that while the word "nincompoops", or its equivalent, is not unknown in my daily conversation, I prefer another description for most of the persons that I occasionally encounter who believe it imperative to repudiate global warming: *well meaning but slightly misguided believers in pseudo-scientific bunkum*.

Under no circumstances do I regard my understanding of this topic as comprehensive or special, even though it takes up a fairly long chapter in my new energy economics textbook (2007), but I feel that one item deserves to be repeated to acquaintances and students until it becomes as ingrained as the General Orders that infantry recruits were compelled to learn in the United States Army when my 'friends and neighbours' voted me into that delightful club. *There are still a few deluded scribblers in circulation who want us to believe that the overwhelming majority of scholars who say that climate warming is the real deal are anti-American and/or anti free-market loony-tunes, while the miniscule number of academic first-raters who insist that the talk about global warming is hysterical nonsense deserve to be honoured as paragons of scientific virtue*!

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As an example I turn to the superstar journalist Paul Johnson, whose intellectual firepower and sustained success puts him streets ahead of the know-nothings identified by Mr. Monbiot as climate warming doubters. I must confess that from time to time I have greatly enjoyed what Mr. Johnson has written, and strangely enough this also applied to his article in the *Spectator* (2004) in which he tells us to "pay no attention to scientific pontiffs" (in the matter of global warming) – unless, I suspect, they are *ersatz* scientific pontiffs. What I particularly liked about that fruitcake advice was that it furnished a modicum of proof that Johnson's high intelligence and access to the corridors and restaurants of power did not make him a wiser human being than those of us who for one reason or another have come to roost much lower on the social scale.

To make a long story short, Johnson regards these scientific pontiffs as snotty neurotics who, because of their shortcomings in dress and/or manners, have no right to interfere in matters dealing with the climate. His principal negative role models are the late Oxford University scientists Henry Tizard and Lord Cherwell, both of whom were scientific advisers to then UK prime minister Winston Churchill during World War II, but who, when summarily banished to academia after the war, morphed into bad-tempered misfits.

Tizard is a man whose life and longings are a complete mystery to me, but I know – which Johnson apparently does not – that Cherwell risked his life during the first world war to show that a spinning aircraft could be pulled out of a dive, and he was also a key player in the design of the UK air defence in the crucial years before the second world war. (I won't bother to go into here what could have happened if that air defence had failed.) Johnson's idea of a real scientist – or "boffin", to use his language – is Bjorn Lomborg of Copenhagen Consensus fame, who is a total non-participant in the genuine scientific literature on any level, and whose recent appointments in the great world of Danish higher education suggests to me the kind of gratuitous welfare handouts that characterize Swedish higher education. As for The Copenhagen Consensus, this is a conclave of well-placed academics who were brought to wonderful Copenhagen on several occasions to discuss topics about which they knew little or nothing, and given their backgrounds and specialities cared less. The only consensus that could be associated with the participants in this half-baked charade was that travel and lodging at the expense of Danish taxpayers is even more gratifying than drinking beer in Copenhagen's Tivoli on a summer evening.

Among other things, Johnson said the United States has done more research on "so-called" climate warming than the rest of the world combined (which is almost certainly true), and this was why – he claimed – President Bush refused to comply with the Kyoto Protocol. Ostensibly, that very expensive research failed to establish a definite link between climate warming and man-made emissions.

Perhaps this described the situation when Johnson's precious composition went to the printer, but it definitely is not the case at the present time. Just a few days ago, President Bush said that "Science has deepened our understanding of climate change and opened new possibilities for confronting it." It has also opened new "possibilities" for understanding certain related prospects that, according to Sir David King, the UK government's chief scientific adviser, might eventually have the same ruinous impact on life and property as a succession of large-scale terrorist attacks. By that he was undoubtedly alluding to physical security and the overall economic outlook. This does not mean that the Chief Executive has become a partisan of the Kyoto 'talkathon', or accepted the scam known as 'emissions trading', but for one reason or another he has decided that he has enough on his plate without challenging the opinions of the overwhelming majority of qualified scientific expertise who reject scepticism in this matter.

One final observation needs to be made here. Monbiot labels the climate warming sceptics "tools of the fossil fuel lobby". I'm not sure that he is correct with that designation, because according to the economics and finance that I teach, the oil and gas people do not need a "lobby" to go to sleep at night with thousand watt smiles on their faces. On this point it is interesting to note how climate warming sceptics have a tendency to flaunt other strange beliefs, one of which inevitably focuses on what they think is the plenitude of energy resources. The gadfly Lomborg, for example, once declared that we do not need to start worrying about an oil shortage in the present century.

I can complete this introduction by confessing that global warming is a topic that I once considered removing from my new textbook – until I became aware of which way the wind was blowing. By that I am not talking about research grants or plane tickets, but the gradual acceptance

by the present *and* the next president of the United States – regardless of his or her name – that global warming deserves serious reflection. I think that mainstream economic theory has no problem proving that the well-off (as a class) would be more discomfited by the melting of glaciers at Courchevel and the flooding of waterfront real estate in Carmel (California) than the poor, even if many footloose plutocrats were still able to afford apartments in e.g. Dubai that are on the block for five million dollars a room, or at the other end of the scale, cosy hideaways on the great south side of Chicago or in Soweto. Wehrmacht Sergeant Christian Diestl in Irwin Shaw's brilliant war novel 'The Young Lions' spoke of the US as "untouched and untouchable", but as things now stand, some extremely choice properties in North America would be in the danger zone in the event of a severe climate meltdown.

Not the Global Warming Movie

"The mind that has feasted on the luxurious wonders of fiction has no taste for the insipidness of truth."
- Samuel Johnson

The purpose of this brief section is to exploit the presentation of global (i.e. climate) warming outlined in a recent book by David Goodstein, who is provost and professor of physics at the California Institute of Technology (2004). Goodstein's thesis, simply put, is that global supplies of *fossil fuels* (oil, gas and coal) are limited, and will largely be exhausted during the present century. Even worse, the carbon dioxide (CO_2) that they will generate during this exhaustion process could provide the basis for an environmental catastrophe that begins with excessive climate warming (i.e. the widely publicized 'greenhouse effect').

There have, of course, been traumatic catastrophes before, however a few decades or so usually sufficed to erase most of their visible traces. I'm thinking here of various plagues that swept across Europe during the Middle Ages, or even the physical and economic devastation that I encountered shortly after World War II when I was an unwelcome guest in Germany and Japan. But the catastrophe being referred to above might take a much longer time to go away. In fact, it is possible to envisage a drastic scenario where, for all practical purposes, it will play a decisive role in the entire future human experience.

The sub-title of Goodstein's book – *'The end of the age of oil'* – is to some extent misleading, because the main issue is not oil but climate warming. But oil is important for the exposition, because the hypothesis being offered is that when it becomes clear that oil is a relatively scarce commodity, there could be a panicky rush into coal (which in theoretical work is sometimes labeled the *backstop resource*), and while there may not be enough economically attractive coal in the crust of the earth to keep the global economic machine operating at full blast for longer than the remainder of this century, there might be an amount that can produce a quantity of CO_2 that is capable of throwing the climate of this planet into an undesirable state. (Remember also that e.g. motor fuel can be produced from coal.)

What we are dealing with here is a theory and not a fact; but since I think that I am still in possession of enough thermodynamics to understand the basis of Goodstein's reasoning, I have decided that it deserves more attention than the sort of thing that we constantly encounter in academic economics, where a few Nobel laureates and Nobel candidates in economics display a comprehensive lack of scientific literacy, and in some cases are little more than agents of various special interest agendas.

The "undesirable state" referred to above would be characterized by a great deal of privation, the consequences of which Goodstein wisely chooses not to consider at great length. However a recent study carried out under the direction of the US Department of Defence (i.e. the Pentagon) drew the conclusion that the television audience will not take kindly to the suggestion that they should assume a *non-motor fuel state of mind,* which would be highlighted by the need to exchange Cadillacs for canoes in order to paddle down flooded roads to the nearest shopping mall. Instead, their political masters might conclude that a less objectionable lifestyle could be obtained if various military resources were used to expropriate the assets of neighbouring states, to include valuable bits of territory.

Goodstein opens himself to attack on two fronts: the first concerns this matter of the exhaustibility of fossil fuels, while the second has to do with the probability of a climate meltdown. I have discussed both of these topics to a limited extent in both my energy economics textbooks (2007, 2000), and in my opinion he is absolutely correct about the first. Fossil fuels are definitely

scarcer than the popular imagination is prepared to concede, and it shouldn't take much more than another decade to bring this distasteful fact home to the most obdurate *flat-earth* economist – as certain self-appointed energy experts are sometimes called. (Readers can also refer to the Organization for Depletion Analysis Centre (ODAC) for an exhaustive review of this topic.)

As for the second, there is still some question as to the magnitude of the probabilities that are appropriate – at least where I am concerned – because I cannot compel myself to entertain the degree of certainty enjoyed by Professor Goodstein. Let me make it clear though that if I were *forced* to choose, I would go with the overwhelming majority of world class scientists (and especially climatologists) who say that global warming is not science fiction, and steps must be taken immediately to reduce the output of greenhouse gases that result from various transportation and production activities. At the same time let me confess that I would not be optimistic about an arrangement in which the opinions of non-scientists, to include myself, were judged to be worth a great deal in this matter, other than when those opinions had to do with identifying certain kinds of charlatans – to include charlatans in the financial world who are manœuvring for seats in the first-class coach of a possible emissions trading gravy train: the kind of scheme that is akin to the major defect in the blunder known as electricity deregulation.

Even if many academic economists are intent upon confusing theoretical contrivances and econometric overkill with scientific proficiency, a few of us have started to review the policies that are or should be adopted to deal with global warming. As alluded to above, this will require a much closer scrutiny of the effectiveness of marketable emissions permits as a tool for limiting the output of greenhouse gases, and also making a fair assessment of the advantages of using nuclear energy. A modicum of assistance may have been received from Hollywood in the form of a 'scare' film with the title 'The Day After Tomorrow', however even if Hollywood truth and objective truth are usually not the same thing, it should be appreciated that this film might help to introduce the general public to some of the background and vocabulary of climate warming.

Although I cannot imagine any enticement short of a very large cash payment that would cause me to personally view this film, I do not take the position of a past chairman of the Intergovernmental Panel on Climate Change (IPCC), which is that Hollywood has done the scientific community a disservice with this 'project'. That gentleman once noted however that if we do not go far beyond what was achieved at Kyoto, then greenhouse gases will continue to increase in the next decade in the same way that they have in the past twenty years. Consequently, I infer that this might be the kind of outcome that is best explained to the voters by a Hollywood extravaganza, instead of a gathering of climate scientists and/or Nobel laureates, or on the other hand a crank congress like Bjorn Lomborg's '*Copenhagen Consensus'*. Why do I think this? I think it because Sweden is one of the most literate countries in the world, and yet the 'cream' of international economists were unable to explain to the Swedish electorate that it was an enormous economic and social mistake to become a part of the European Union (EU), or to accept electric deregulation.

The United States government failed to ratify the Kyoto Protocol, but even so that country is such an impressive supporter of climate research that I cannot help believing that if the Kyoto Protocol made economic sense, then President Bush would not have any problem supporting it, since it was his father who signed into existence the Framework Convention on Climate Change, which initiated the process leading to Kyoto.

But to my way of thinking it does not make ANY economic sense at all, although for reasons that do not correspond to those originating in the West Wing. To begin, if the 2500 delegates to the Kyoto meeting had been serious people, then a large number of them would have insisted that *immediate* steps should be taken to reduce carbon dioxide (CO_2) emissions, instead of waiting ten years to install what the prominent New Zealand economist Owen McShane has termed a *pseudo market* for trading emission permits. Insistence was not their way of doing things however, because first and foremost many of them did not want to risk not receiving invitations to subsequent global warming jamborees.

The Kyoto meeting also ignored the obvious beneficial effects that nuclear energy has in the matter of reducing the stock of atmospheric CO_2. This unfortunate oversight can perhaps be indulged, because regardless of the personal beliefs of voters about nuclear energy, to include the fact that a majority of them are favourable, most politicians are capable of recognizing that (anti-nuclear) environmentalists often have an amount of political power that is completely out of proportion to their numbers, and this has been particularly true in countries like Sweden and

Germany. I would like to suggest though that in the kind of world in which these environmentalists claim that they want to live, an increase rather than a decrease in nuclear based power might turn out to be the optimal strategy.

In the film referred to above, the son of the hero finds a place in the Manhattan Public Library to rest his weary bones from the havoc raging in the streets of 'The Big Apple'. The implication is that in a library which contains a large slice of the world's wisdom, it should be possible to uncover the kind of scientific knowledge that will keep New York City from ending up at the bottom of the Atlantic Ocean. But in my candid opinion it would have been more appropriate if that young man and his friends sought refuge in a phone booth with a direct line to people like Clint Eastwood or Bruce Willis, because there is nothing in any book ever written, or perhaps can be written, that is capable of explaining how to restore the kind of life that we enjoy today in the wake of a climate warming catastrophe. Instead, what we require is access to platoons of Eastwood/ Willis 'space cowboys' or 'asteroid tamers' – noble men and women who, assuming that they exist in the real world as well as on the silver screen, possess the kind of charisma, street smarts and metaphysical assets that would allow them to plunge down into the depths of the Gulf Stream and deal with nature on its own terms.

According to Marshall and Lynas (2003), every scientific institution and national government in the world now endorses the conclusions advanced by the IPCC that global warming is a major threat to the planet's future. This sounds to me like a slight exaggeration, although it is compensated for by their presentation of a quotation by John Gray in his book *Straw Dogs*: "The mass of mankind is ruled not by its intermittent moral sensations, and still less by self-interest, but by the needs of the moment." I completely agree, because exhaustive self-interest involves thinking ahead, and so the implication is that the "needs of the moment" will prevent even intelligent people from taking action on things like climate change until its effects are extreme. Of course, by that time, where *this* particular phenomenon is concerned, it will probably be too late. This is a major reason why I am against meetings of the Kyoto and Rio variety: they reinforce the impression that significant progress can be made in solving any problem *merely* if the right signatures are put on this or that document.

My recommendation where the climate warming issue is concerned is to go beyond mastodon conferences, and to work at the highest political level. The reason is that if this problem is not solved, we may eventually find ourselves confronting something that cannot be put right by the expenditure of trillions of dollars, or the ruining of tens or hundreds of millions of lives: something characterized by the kind of complexity that run-of-the-mill conference delegates without immediate access to the best available scientific expertise cannot possibly be expected to comprehend, even if by some miracle they were inclined to do so.

But should it happen that these delegates comprehended it perfectly, there is no guarantee that they would take the optimal action, because as Marshall and Lynas would probably suggest in a more comprehensive analysis, it might disturb the particularly acute form of self-denial that characterizes the people who foolishly paid for their plane tickets and hotel rooms of this travelling circus. My memory may be vague on this subject, but if I remember correctly the looks on the faces of men and women in the badly damaged cities of Germany and Japan were mostly expressions of confusion. They simply couldn't figure out how things could have gone so badly for such wonderful people as themselves, although if they had asked and if I had known at that time (which I didn't), I would have been more than happy to clarify the situation for them. I wouldn't however have said that it was a matter of "implicatory denial", or "cognitative dissonance", to use the terminology of Marshall and Lynas, but simply referred to a famous old adage: *when you dance, you eventually have to pay the piper – and this is true even if he is a rotten musician*!

The thing to take notice of is that in a situation where dancing and its joys is a metaphor for an increasing rate of consumption of increasingly scarce fossil fuels, an illogical faith in renewable energy, a sanctimonious rejection of intrinsically safe nuclear energy, a naive resort to gimmicks like emissions trading, and the counterproductive tolerance shown climate-change deniers who confuse the issue by calling world-class climate scientists propagandists and myth-makers, paying the piper could easily involve something bordering on bankruptcy for a large part of the human race, particularly if the global warming wolf turns up at the door in his take-no-prisoners mode.

Nuclear in the Light of "Kyoto"

Several years ago I published a paper in *Geopolitics of Energy* with the title 'Some Aspects of Nuclear Energy and the Kyoto Protocol' (2000). On the first page of that issue, the editor of the publication at that time, Vincent Lauerman, asked the following very relevant question: "Is 'Kyoto' a lost cause without the mass deployment of nuclear power plants? He added that "the current debate on this topic is long on ideology and short on reason."

That almost sums it up. 'Almost' because basically what we are dealing with here is a shortage of the kind of information that would encourage not the "mass" but the *optimal* employment of nuclear facilities. (Optimal is a very important term in mainstream economics. It means choosing the *best* patterns of affordable consumption or production, given the presence of adequate information about available choices, and enough rationality to distinguish between different (e.g. good and bad) outcomes. In the *real* world, where inter-temporal considerations dominate, this is asking for a great deal.) In any event, in theory, the general public's uncertainty where nuclear safety and waste disposal are concerned must be respected, while at the same time recognizing that a majority of this same public desires inexpensive and reliable electricity, as well as the absence of a potentially dangerous accumulation of greenhouse gases. In particular, an excessive output of carbon dioxide (CO_2) is to be avoided. When all restraints are taken into consideration, we have an optimization problem that is analogous to those in e.g. your favourite intermediate level microeconomics textbook.

Ordinarily my approach to this quandary would begin with a reference to the greatest of all scientists, William Shakespeare: "*Time's glory is to calm contending kings, to unmask falsehoods, and to bring truth to light."* The riddle here is whether we will have time to bask in the truth and its raptures before we take to the roof tops. My research has often focused on the ugly things that could happen due to e.g. electricity deregulation and an unexpected shortage of oil, but these are trivial as compared to a global warming calamity. It has been said that in confronting the problem of global (or greenhouse) warming, "the choice is between action and delay", and as far as I am concerned, "action" means giving more weight to the nuclear option, beginning immediately.

Not everybody is prepared to entertain this kind of language or reasoning. Several years ago the presiding European Union (EU) environmental minister, Ms. Margot Wallström, stated that it would be possible to fulfil the stipulations of the Kyoto Protocol without resorting to nuclear energy. She was in some sense echoing the twisted beliefs of her previous colleague the Swedish prime minister, who on several occasions referred to nuclear energy as "obsolete". It would appear that an investigation of some sort had been published which Ms. Wallström and/or her staff scrutinized, and in this document it was claimed that a carefully selected combination of carbon taxes and emissions trading can prevent such inconveniences as floods and excessive temperatures. Unless I am mistaken, at least one version of this idea originated with a gentleman to whom I taught mathematical economics many years ago, however, regardless of its source, the only thing that it has to recommend it is that it has caught the attention of some movers and shakers in Brussels.

What is the main shortcoming of this new proposal? My answer is that suppression programs for greenhouse gases that exclude or downgrade nuclear energy, and also an urgent, extensive and *direct* regulation and/or elimination of these 'pollutants' *by whatever means are necessary*, are little more than an elaborate lottery: the kind of lottery for which innocent bystanders own a ticket whether they know it or not – at least until the water starts rising on the Reeperbahn or Canal Street. The basic problem is that well-meaning persons like Ms. Wallström and her advisors have grossly overestimated the practical value of various pollution suppression schemes that are featured in the speeches of politicians or for that matter the learned journals of economics. These digressions offer very little that is applicable to the real world.

I often discuss this subject in terms of the situation in Finland. For the last forty years the school children of that country have been at or close to the top of the OECD in academic achievement, and in 2006 they were first of all the children in all the world according to a UN survey. This tells me that the government of that country is less likely to make a mistake in the matter of choosing the correct energy inputs than e.g. the bureaucrats and voters in some principality on the rim of the Kalihari. In addition, two major natural gas suppliers can be found close to the western and eastern borders of Finland, but they were ruled out on economic and perhaps environmental grounds. As for nuclear energy being obsolete, many scientists have called the nuclear reactor the most important scientific discovery of the 20th century, but regardless of its distinction, it is clear that an enormous degree of upgrading will eventually be possible on nuclear equipment in

regard to the processing of fuel and nuclear waste. It might also be useful to mention that the reactor that is under construction in Finland, which is the largest in the world, should have a life of at least 70 years. In 70 years natural gas in quantities large enough to keep the people of that country warm during those long Finnish nights could be selling for the same price as gold and diamonds.

Returning to the first paragraph of this section, we are entitled to ask if an increased deployment of nuclear assets can 'save' 'Kyoto' – or more correctly, the United Nations Framework Convention on Climate Change that was broached at Kyoto, Japan, in December 1997. The conclusion presented in my new textbook is that nothing can save 'Kyoto' except its (formal or informal) abandonment, and replacement by a more realistic alternative. As I pointed out elsewhere, "finding compromises that can satisfy all participants in the environmental wars must be as frustrating as the search for the Holy Grail (or the Fountain of Youth), but had the delegates at Kyoto genuinely believed that global warming (due to increasing atmospheric concentrations of greenhouse gases) constitutes a clear and imminent danger, they would also have realized that the final document served up to them was inadequate, and unless a radical extension of its provisions can be adopted (and implemented) in the very near future, greenhouse gases will continue their build-up in the same way that they have during the past few decades" (2000c).

(Something else those delegates would have done if they had been serious persons capable of comprehending the subtler aspects of global warming, was to insist on the immediate adoption – if only in a token sense – of measures that were absolutely and without any doubt capable of reducing atmospheric pollution. As bad luck would have it, most of them were too busy trying to ensure that they qualified for a ticket to the l998 climate warming get-together in Buenos Aires to become heavily involved with theoretical niceties.)

Will the present or an accelerated build-up of greenhouse gases be instrumental in bringing about a collapse of our civilization and the destitution of coming generations? A large majority of our scientific elite say that many ugly realities and surprises might have to be accommodated unless there are some drastic alterations in our outlook and behaviour. Once again I would like to emphasize that to me this means doing something about the uncertainty mentioned earlier, which in turn calls for a greater reliance on nuclear energy. *With nuclear energy we know what we are getting. We are not investing in a CO_2 lottery!* Most of the other approaches – and particularly playing games with emissions permits – maintain or increase uncertainty via the fabrication and retailing of unproved hypotheses and/or conclusions.

In the very long run, of course, we are moving toward what could be an exciting panorama of renewables and quasi-renewables. Whether this will turn out to be a comprehensive or even fragmentary paradise on earth remains to be seen, although I for one have some problem believing that on a global scale, the corpus of economic and social losers will greatly diminish in size. The thing to remember is that according to the OECD, two-thirds of the increase in energy demand between 2000 and 2020 will come from developing countries, where as already mentioned several billion persons lack an adequate or reliable supply of electricity. Some question should then be asked whether the persons experiencing this shortage prefer their future well-being to depend on renewables or traditional sources of energy – where traditional in the present context means uranium or fossil fuels. If they choose the latter, then we might be talking about irreparable damage to the environment – and this could happen even if fossil fuels are quickly exhausted. (See Goodstein (2004) for an elementary examination of some aspects of this quandary.) But if that happens, then we are worse off than ever because of the steady increase in global population.

In a short article in *The Spectator* (2004), Rod Liddle said that according to the UK Royal Academy of Engineering, nuclear is the least expensive way to generate a unit of electricity: on average, it is one-half the cost of coal, and about 40% less than the cost of gas. A similar conclusion was arrived at in France, where a former prime minister, Lionel Jospin, organized a study to clarify the competitiveness of gas with respect to nuclear energy. Jospin's instructions were to take *all* costs into consideration, to include those of an external nature (e.g. environmental costs). The verdict was that there would not be great cost differences between gas and nuclear as long as there was no escalation in gas prices. As things turned out though, not long after the contents of the report had been fully digested by anxious readers, the price of gas almost doubled. Thus, another potential controversy involving 'greens' and their adversaries could be removed from the government's table, although those persons with a "no thanks" approach to nuclear

power continued to be unimpressed or for that matter uninterested in arguments with a pronounced reliance on facts and figures.

Almost everywhere in the world, the life of existing nuclear installations are being extended, and new facilities are being planned. For instance, life extensions are also almost certain for the bulk of the UK's nuclear capacity, especially since the outgoing prime minister, Tony Blair, has said that "if you are serious about climate change, then it's wrong to close the door on new nuclear development." A group in Sweden called "Environmentalists in favour of nuclear energy" would almost certainly agree with this evaluation, even if the sheep-like passivity of Swedish consumers allowed misfortunes like electricity deregulation and the dismantling of the nuclear sector to begin. Another item that is relevant in this context is that natural gas not only contains CO_2 (though not nearly as much as oil), but methane, and some researchers say that if very large quantities are involved, methane can pose environmental dangers on the order of excessive CO_2.

At the 1998 European Nuclear Conference, Dr. Hans Blix – who later became heavily occupied in the search for 'weapons of mass destruction' in Iraq – provided delegates with a series of highly relevant queries and observations. These included or should have included a number of facts, where one of the most interesting was that in France, which generates close to 80 percent of its electricity in nuclear installations, the emissions of CO_2 per kilowatt hour were about 64 grams, while in the UK, which had a much smaller amount of nuclear, and as a result uses a considerable amount of gas and coal, emissions were 10 times larger. Similarly, in Sweden, where nuclear and hydro generated most of the electricity, the figure was 58 grams/kilowatt-hour, as compared to Denmark – which even at that time had a large inventory of wind turbines, but relied for the most part on coal – the figure was 917 grams/kilowatt-hour.

What is not generally understood is that the Danish resort to wind-power can be justified by the high cost and pollution that characterizes their dependence on coal. This situation does not apply to neighbouring countries, and in particular Sweden and Norway. It is also interesting to note that the use of wind-power appears to be peaking at the present time, which may be due to the inability to fit it into the deregulated Danish electricity market – which, like most deregulated electricity markets on the face of the earth has encountered considerable difficulty in honouring its promises to the households and firms of that country. This might also be the place to inform coal intensive Denmark that a 1000 MW_e coal-fired power plant releases almost 100 times as much radioactivity into the environment as a comparable nuclear plant. In addition, as the World Nuclear Association pointed out, "if all the world's nuclear power were replaced by coal fired power, electricity's carbon dioxide emissions would rise by a third".

While on this subject, it can be noted that according to Liddell, 18 million tonnes per year of CO_2 is avoided because of the presence of the UK's nuclear energy, which he states is equivalent to five car-free days per month. For Europe as a whole, Dr. Blix says that nuclear power helps to avoid the emission of approximately 700 million tonnes of carbon dioxide a year. This is a very large number, and one would like to think that had it been circulated to the several thousand delegates at Kyoto, or the 60,000 at Capetown for the so-called 'World Summit', enough of them would have been sufficiently motivated to abstain from their eating and drinking long enough to realize that there were passages to environmental sanity that did not involve the uncertainties implicit in the 'green message'.

Emissions Trading Blues

In a recent article in the *Financial Times* (June 1, 2007), Phillip Stephens states that according to IPCC studies, the economic costs of curbs on carbon dioxide are relatively small when weighed against the danger of inaction. This was certainly true at the time of the Kyoto burlesque, and it may be true today. He also says that the answer is to fix a "realistic international price for carbon through a cap-and-trade system." President Bush has rejected this harebrained solution, although unfortunately he may change his mind when enough journalists, economists and pollsters insist that this bogus setup has some scientific and/or political merit. Here we are dealing with exactly the same kind of naiveté, ignorance, greed and/or hypocrisy that preceded the deregulation of electricity in California and Sweden, and which in Sweden (and probably elsewhere) is still tormenting ratepayers.

At the Kyoto meeting, nuclear energy was by and large overlooked, and probably was not even on the agenda, however it was decided that a market would be established for the trading of emission permits. For some reason this crazy concept has roused the enthusiasm of the low-and-powerless as well as the high-and-mighty, and once this emissions bazaar is fleshed out with

confused buyers and sellers of permits, as well as bright-eyed young people functioning as market makers and/or brokers, it will take its place in the cavalcade of serviceable falsehoods. In many respects it will likely be similar to the uniformly inefficient establishments and schemes that were introduced to enable the risk associated with electricity deregulation to be hedged.

I hope that I am not revealing my basic frame of mind in this matter when I say that emission permits are one of the worst ideas ever formulated, and the cost – both in dollars and millions of tons of CO_2 propelled into the atmosphere – would make it a distinguished non-starter if there had not been a small group of academic economists, and a large group of finance professionals, who expected to gain personally from their introduction.

I doubt whether all readers of this exposition will appreciate merely being told that emissions trading is a silly misadventure. Rather than ignore these ladies and gentlemen, let me suggest that they should ask their favourite economics teacher for a deeper insight into the interior logic of this undertaking, and given the high probability that he or she won't have a clue, they should also consult the superb microeconomics textbooks that are now available, or better examine the easy-to-read articles of David Victor (2000) and Ruth Greenspan Bell (2006), and the short note of Taylor and VanDoren (2006). Like myself and Professor William Nordhaus, Jerry Taylor is "sceptical of emissions trading regimes that might result from international agreements", and prefers a global carbon tax. It is also my happy obligation to inform readers of this paper that all the pages in all the textbooks and articles that have been written since Adam and Eve will not provide them or anyone else with the expertise required to convince intelligent persons that emissions trading has any genuine merit. As President Putin was summarily informed by one of his experts, "it's a scheme to make money, and has nothing to do with suppressing pollution." Let's put this another way: by adopting emissions trading instead of a direct and systematic program for reducing greenhouse emissions (e.g. via nuclear energy, and carbon taxes and perhaps subsidies), we have another situation in which we express our preference for a lottery instead of a sure or near-sure thing.

Conclusion

"The environment is not a machine. It is full of surprises."
- Professor Bert Bolin

If the rationality mentioned in the first sentence of this paper prevailed, that pretentious 'outfit' for relentlessly bilking the unwary, the Nordic Electric Exchange (NORDPOOL), would have had its doors closed and nailed shut years ago, and not only electricity but emissions trading would strictly be a topic for term papers at storefront universities in Boston and New York. But sadly that would not have alleviated all of our electric and environmental worries.

In Ross Gelbspan's book 'The heat is on' (Addison-Wesley, 1997), he makes the following brilliant remark: "Scientists do not know what hidden thresholds lie ahead. They do not know what feedbacks will take effect, or when. They do not know at what point an unstable climate will become a cascade down a steep slope. They cannot yet predict whether or when the rate of warming will accelerate. So those who are trying to avert the crisis are left groping in the dark, forced to choose arbitrary emissions-reduction targets that are determined more by their political viability than by their correspondence to the actual situation."

He is talking about non-linearities here, so what does he want done? One option is to convene another elephantine talk-shop, and keep it in session until it gives the impression that significant progress can be made in reducing environmental hazards if the right signatures are affixed to this-or-that document. The opinion here, however, is that decisions having to do with liquidating the global warming threat should be made by heads of state – where these decisions include actions that should be taken in the event of non-compliance. By actions I am not thinking of gunboats, but economic restrictions. The thing to appreciate is that we are not dealing with brownouts or irksome increases in motor fuel prices, but if things go wrong, possible disasters that in earthquake terminology belong at or above the top of the Richter scale. Of course, if you believe the recent statement by President Vaclav Havel (of the Czech Republic), none of this is relevant, because in his words Al Gore is "insane". What Mr. Gore is – according to his own contention – is a bad dancer. Insanity describes the persons who have advised President Havel on this subject.

An extension of the topics discussed above can be found in the work of Barry Naughten of the Australian National University (Barry.Naughten@anu.edu.com). His recent work (e.g. 2007)

contains some useful observations about the position of Australian prime minister John Howard in the climate debate. In the interests of himself and his party, Mr. Howard's stance will almost certainly have to be reassessed now that President Bush has found his denial of global warming a political encumbrance. There is also a very strong possibility that the men and women in the president's temporary and permanent social circle have expressed some alarm about recent weather patterns.

One of the most brilliant and influential physicists of the 20th century, Niels Bohr, once said that "true expertise comes only after making all possible mistakes." By way of contrast, I think it wise to accept that in the matter of global warming it might be a good thing if we avoid certain types of mistakes, since this expertise might have to be demonstrated in a world with a new and disagreeable economic and political structure – a structure that is not particularly responsive to the application of traditional know-how, behaviour and aspirations, but is punctuated by the sounds of gun-ships and assault rifles.

All of the above and a great deal more should be taken specific note of by those persons who have become receptive to the arguments of the small but strident group of dissidents who allege that global warming is a hoax, or the deregulation buffs who insist that showy but impotent departures like emissions trading have a serious role to play in slowing climate change.

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